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TITLE OF THE INVENTION

SELF PROPELLED BACKFILLING APPARATUS

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SELF PROPELLED BACKFILLING APPARATUS

BACKGROUND OF THE INVENTION

This application claims the benefit of U.S. Application No. 09/498,712 filed on February 7, 2000.

1. Field of the Invention

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The present invention relates to heavy equipment used in construction. More particularly, it relates to large earth moving machinery used in trenching and pipeline construction and the device, as herein disclosed, provides extremely accurate user control over the placement of soil and other material used to cover buried pipelines and to backfill structures during heavy construction.

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2. Prior Art

Construction projects involving the removal and replacement of soil have been ongoing for thousands of years. Inevitably, construction projects large and small require the exacting removal and repayment of soil in trenches, behind walls, and over pipelines and cables. Placing sand, stone or gravel in a tight area can be one of the most time-consuming and costly tasks at a construction job site. Material may need placement to exacting specifications especially when covering pipelines and other underground utilities. Additionally, there may be concerns about disturbing the surrounding environment by using heavy machinery

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1 to place aggregate materials, should those materials be misplaced
by the machine operator. Careful placement of many fill
materials is also a must in modern construction since many times
pipes, tanks or other under slab materials are damaged using
conventional backfilling.

6 Normally, the gravel, aggregate, soil, or other material to
be used for the fill stream arrives and is dumped on the ground
and is then loaded into a hopper of the machine which will
deposit the fill where it is needed. Depending on the size and
access available to the job site, this can take several men and
1 machines many hours to complete. Not only is this an outdated
process, but inefficient and costly to project owners and
contractors. On large projects such as pipelines, many tons of
fill material can be lost in the transferring process, as well as
the risk of accidental placement of material improperly or in a
16 fashion that actually damages the pipeline itself.

Consequently, there exists a need for an apparatus which
will provide for the easy transport and placement of fill
material constantly used in construction projects. Such a device
should provide for the easy transportation of the material itself
21 without excessive loss during transport. Additionally, such a
device should provide the user an easy manner to place the
material according to even the most exacting job specifications.

1 Further, such a device should also allow the user to accurately place fill material while concurrently avoiding damage during the burying of pipelines, cables, and other infrastructure that is commonly buried. Finally, the device should maintain its own center of gravity to prevent tipping.

6 SUMMARY OF THE INVENTION

Applicants' device is an easily mounted and operated apparatus capable of use as a complete backfilling unit with material reservoir or hopper for storage and transport of fill material, a conveyor, and a fill material flow director. Or, in some instances, components of the device may be manufactured for mounting and use in combination with existing conveyer systems used in the placement of fill material. The device in the current best mode of a complete unit features a hopper for holding fill material such as gravel, sand, soil, or similar conventionally used materials. The hopper is mounted upon a chassis or support structure of a vehicle that is moveable by conventional wheel and axil or tread mounted systems of propulsion. A telescopic conveyer system is also mounted upon the chassis in a position to receive material from the hopper at one end and convey that material to the distal end for placement in trenches, behind wall, over pipelines, and in similar conventional positions in which fill is required.

1 In the best mode, at the distal end of the telescopic
conveyor, a means for direction of the fill stream is provided by
a flow director. However, the combination of the hopper which
corrects its own center of gravity with the conveyor by itself is
a vast improvement over current technology using a backhoe and
6 dump truck full of dirt. In the best mode, the flow director is
attached to the distal end of a conveyor means in this case
depicted as a telescopic conveyor belt and constantly receives
the fill material transported by the conveyor from the hopper of
material on the device. As the conveyor is telescoped in or
1 out, the flow director being attached to the distal end of the
conveyor belt support structure is positionable by the machine
operator to where fill is to be placed. Attached just below the
point where the conveyor belt discharges the fill material
carried upon the moving belt, this flow director is always
16 positioned to receive the fill material from the hopper and
transported by the conveyor.

The flow director features a pair of channeling ramps
connected by an axil to a strut which communicates with the
distal end of the support structure for the conveyor belt. The
21 strut provides a mount for one end of each channeling ramp. The
distal end of each channeling ramp is independently positionable
to an infinite number of positions by a means for elevation of

1 the channeling ramps in the form of a hydraulic ram. The
hydraulic ram is controllable for elongation by the machine
operator from the cab in the conventional fashion of such
devices. The operator may elongate the ram to raise the attached
channeling ramp to change the position of the distal end of the
6 channeling ramp. By changing the position of one or both distal
ends of both channeling ramps, the operator gains extremely
precise control of the position in which the fill material is
placed. Lowering both will provide a narrow but straight stream
of material while raising both to the maximum will bifurcate the
11 fill stream and place half of it on one side and the other half
of the stream a distance from the first equal to the distance
between the two distal ends of the pair of channeling ramps.
Optionally, a swivel can be added to the strut allowing the
operator to swivel the channeling ramp off the position parallel
16 to the conveyor belt to allow for angled placement of fill.

Additional utility is provided by a means for altering the
center of gravity of the hopper. This solves another vexing
problem that exists with large machinery which in itself is heavy
and becomes even heavier when carrying fill material. Such
21 machines conventionally are prone to tip over when the machine
encounters a grade. The means for altering the center of gravity
of the hopper allows the user, or a computer, to adjust the

1 angle of the hopper from a normal position in relation to the
frame of the machine to an ever increasing angle, depending on
the grade encountered and upon the weight of the fill placed in
the hopper. In this case, by using an axil mount at the base of
the hopper and a hydraulic ram to tilt the hopper one direction
6 or the other, an infinite number of different positions may be
established for the hopper and a resulting number of adjustments
of the center of gravity of the assembled machine to traverse the
grade encountered.

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1 An object of this invention is providing an easily used and
maintained apparatus which provides for extremely accurate
placement of fill material on construction sites.

It is a further object of this invention to provide an
easily manufactured and operated fill material channeling ramp
that may be attached to conventional conveyors when needed as an
16 attachment.

An additional object of this invention is to provide a
device allowing for use on steep grades by the adjustment of the
center of gravity of the load carried by the device during use.

21 A further object of this invention is to minimize the waste
and misplacement of fill material during backfill and burying of
pipelines and underground utilities.

Another object of this invention is to reduce the risk of

1 damage to an infrastructure such as pipelines and other utilities
during the burial phase of their construction.

Further objects of the invention will be brought out in the
following part of the specification, wherein detailed description
is for the purpose of fully disclosing the invention without
6 placing limitations thereon.

BRIEF DESCRIPTION OF DRAWING FIGURES

Fig 1 is a side view of the device showing the fill material
hopper mounted on a powered vehicle with the flow director
11 attached at the distal end of a conveyor belt.

Fig 2 is a side view of the flow director attached at the
distal end of a conveyor belt depicting the two channeling ramps
adjusted for placement of fill material.

Fig 3 is a side view of the conveyor with the channeling
16 ramps in a retracted position for a narrow pour of the bifurcated
material stream.

Fig 4 depicts the independently adjustable channeling ramps
in unequal positions to bifurcate the fluid stream unevenly.

Fig 5 depicts a side view of the self powered vehicle on an
21 incline with the hopper adjusted to change the vehicle center of
gravity.

1 Fig 6 depicts and additional preferred embodiment of the
device with fixed or extendable conveyors which can be positioned
to deposit fill when a bifurcated material stream is not needed
and with a conveyor that can optionally be raised or lowered.

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**DETAILED DESCRIPTION OF THE PREFERRED
EMBODIMENTS OF THE INVENTION**

Referring now to the drawing Figures 1-6 depict the various
components and interrelation thereof in operation of the
disclosed device 10. Figure 1 depicts a side view of the device
10 as it would appear in operation as a complete unit. While it
is anticipated that components of the device 10 can be
manufactured as attachments to conventionally used back filling
devices, the current best mode of the device 10 works best as a
complete unit with a hopper 12 for holding and transporting fill
material, a conveyor means such as the depicted telescopic
conveyor 20, and a material stream flow director 14, functioning
in a symbiotic relationship to each other.

The device 10 in the current best mode of a complete unit
features a hopper 12 which is filled by the user with one or
combinations of conventional fill materials such as gravel, sand,
soil, or similar conventionally used materials. The hopper 12

1 is mounted upon an attachment point depicted in this case as the
hopper axil 46 to the vehicle chassis 16 of a powered or self
propelled vehicle 18. The self propelled vehicle 18 may be
powered by conventional means for vehicle power such as gasoline
or diesel engines which provide power via communicating hydraulic
6 pumps or by drive shafts communicating the power to wheels and
pump combinations or in other conventional means of powering a
wheeled or treaded or similar such piece of construction
equipment.

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1 A conveyor means depicted by a telescopic conveyor 20 is
also mounted upon the chassis 16 by a support structure 26 which
defines the dimensions of the conveyor 20 built around it. The
conveyor means could also be a fixed length conveyor but in the
current best mode the conveyor means is a telescopic conveyor 20
and provides the most utility. This is because it is adjustable
16 for positioning the distal end of the conveyor 20 and the flow of
fill material 22 leaving that end, at the location desired for
deposit of the material 22. Since the receiving point for the
fill material 22 is generally in trenches, behind walls, over
pipelines, on top of power lines, gas pipes, and other
21 infrastructure utilities that are buried, adjustability in the
form of the telescopic conveyor 20 provides the user greater

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1 adjustability for the flow of fill material 22 to the desired
location. With more effort, a fixed length conveyor could also
be used but the telescopic conveyor 20 is the current best mode.

The conveyor 20 works in the conventional manner of conveyor
belt systems and transports fill material 22 communicated from
6 the hopper 12 at the receiving end 23, and conveys that material
22 on a rotating belt 21 to the distal end 24 for placement in
desired location. The belt would be powered by a conventional
means for powering the rotation of the belt such as a hydraulically
powered motor or electric motor. At the distal end 24 of the
11 conveyor 20 a means for adjustably bifurcating a communicated
stream of fill material is provided by the flow director 14. The
flow director is attached to the distal end 24 of the conveyor
means in this case conveyor 20 in a position to constantly
receive substantially all of the fill material 22 communicated by
16 the conveyor 20 from receiving end 23 which receives fill from a
discharge aperture 11 operatively position in the hopper 12. If
mounted to the conveyor 20 which is of fixed length, the flow
director 14 remains fixed in position relative to the ground
attached to the distal end 24 of the conveyor 20. This would be
21 acceptable in instances when access to the target for the fill
stream is easily obtained and maintained. When mounted to the

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1 point determined by the minimum length of the hydraulic ram **36**,
which rotates them on the ramp axil **30** as depicted in figure ²3/
and the high point of elevation of the distal ends **34** depicted in
figure 2, as determined by the maximum extension of the ram **36**,
which rotates them on the ramp axil **30**. The operator by
6 elongating the ram **36** using conventional controls, may change the
position of each of the two different distal ends **34**
independently to adjust the landing point for the material stream
discharged from that distal end **34**. Changing the positions of the
ramps **28** thus provides a means to direct each of two separated
1 material streams to a separate individual target position below
the distal end of said conveyor **20**. This allows the user to take
the bifurcated material stream and direct two separate streams of
material to a bury a target to be covered on the ground, such as
a pipe or trench, by a means for independent elevation of each of
16 the channeling ramps **28** in the form of a hydraulic ram **36**.
Electric solenoids or rack and pinion gear mechanisms might also
be used to provide the means for independent elevation of the
channeling ramps **28**, however, the current best mode uses
hydraulic rams **36** since the majority of heavy equipment of this
21 type are powered by on board hydraulic systems which also provide
power for the conveyor **20** and self propulsion using treads **50**

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1 receiving power from a hydraulic motor. The hydraulic ram 36 is
controllable for elongation and contraction by the machine
operator from the cab of the powered vehicle 13 in the
conventional fashion of such devices which have a laterally
translatable arm moving in and out of a cylinder. The engine
6 providing propulsion by powering the hydraulic pumps or electric
motors would be operatively mounted to the chassis of the vehicle
13 in a position to allow operative communication with the
control levers in the cab 15 which allow the operator to control
the various functions powered by the engine. The operator may
11 elongate the ram 36 to raise the attached channeling ramp 28 and
thus change the position of the distal end 34 of the channeling
ramps 28, or he can shorten the ram 36 to lower the ramps 28.
Each ram 36 is independently adjustable to thereby swing the
attached channeling ramp 28 on the ramp axil 30. The user can
16 thus independently adjust the position from the low point or the
center axis of trench or pipe or other item to be buried by
adjustment of one or both distal ends 34 of both channeling ramps
28 from centerline between the low point of adjustment. The
operator can thereby control the deposit position and quantity of
21 fill material deposited from each of the two parts of the
bifurcated stream of fill material 22 being split. This

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1 individual adjustment of quantity of fill material so deposited
provides the operator extremely precise control of the position
and quantity at which the fill material 22 communicated to the
flow director 14 by the conveyor 20 is placed. Lowering both
channeling ramps 28 to the low point where the distal ends of
6 each channeling ramp are substantially adjacent to each other
will move the distal ends of the channeling ramps 28 over to the
center axis of the trench or pipe or other item being buried, and
provide a narrow but straight directional stream of fill material
22 to a single point. Conversely, raising both channeling ramps
1 28 to the highpoint or maximum position essentially perpendicular
to the center axis of the pipe or trench, will move the distal
ends of the channeling ramps further away from the center line
and will bifurcate the communicated stream of fill material 22 to
a maximum distance from center line of the trench, pipe, or other
16 object being covered with fill.

Adjusting the angles of the ramps 28 also provide a means
adjustably bifurcating the volume of the two separate streams of
fill material and thereby allows the operator to place a defined
amount of fill material 22 in one location at the narrowest point
21 of separation of the distal ends, or defined amounts of the
communicated fill material 22 in two different target locations.

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1 Since both of the channeling ramps **28** are independently
adjustable, there is an infinite number of positions for the
distal ends **34** of the channeling ramps **28** in relation to each
other and the center line of the object being buried by the fill
material thus allowing for an infinite number of adjustments of
6 the quantity, as well as the target location of each section the
streams of fill material being deposited. Further means of
adjustingly bifurcating the amounts of each of the two streams of
fill material being deposited is accomplished by using remote
controls for slowing, or speeding the rate of forward speed of
11 the belt **21** toward the distal end of the conveyor **20**. By
adjusting the motor that runs the conveyor and thus the speed of
the conveyor belt **21** the amount of fill material deposited on one
or the other of the channeling ramps **28** can also be adjusted.
This results because a faster speed of the belt **21** conveyor **20**
16 will produce more inertia on the fill material and naturally
cause more material to be deposited further away from the
conveyor distal end **24** causing more fill material **22** to deposit
on the outer channeling ramp **28**. Conversely slowing the speed of
the conveyor **20** will cause an equal distribution to each of the
21 pair of channeling ramps **28** with an even slower belt speed
causing more material to deposit on the closest of the ramps to

1 the distal end of the conveyor 20, and less on the outer
channeling ramp 28.

Since the flow of material can also be adjusted by
resistance provided by gravity in relation to the upward angle on
the channeling ramps 28, the user can also adjust the flow and
6 volume of the two separate streams of material 22 by increasing
or decreasing the downward angle of the channeling ramps 28 in
relation to a position normal to the angle of the conveyor 20. A
steeper angle will cause less back pressure on the steam of fill
material falling onto the ramps 28 causing a faster fall and more
1 material flowing down that ramp. A less steep angle will cause
the material to stay upon the channeling ramps 28 slightly longer
due to friction caused by gravity on the fill and thereby cause
back pressure in the flow of the material resulting in less
material reaching the designated position. By adjusting the
16 channeling ramps 28 to different individual angles, the operator
can precisely deposit more or less fill material to the desired
target from each of the channeling ramps 28 causing more fill
material to be deposited from one ramp 28 than the opposite ramp
28. Combinations of these different means for adjustingly
21 bifurcating the flow and thus the volume of deposited fill
material can be achieved by combining one or combinations of the

1 aforementioned speed control of the conveyor 20 and the angle of
the channeling ramps 27 and 28.

 This ability to deposit fill material precisely on target
and in precise volume, is especially important in the backfill
operation involving pipelines and other trench buried

6 infrastructures. The aforementioned means for adjustably
bifurcating the stream of fill material, and the means to direct
each of the two separated material streams to an individual
target position below said distal end of said conveyor

allow increased precision as depicted in figures 2-5. As

11 depicted, each of the channeling ramps 27 and 28 have been
adjusted to a downward angle to yield the precise volume of

material 22 to be deposited in the precise target position on
below the distal end of the conveyor 20 on either side of the
centerline of the trench being filled, or, on adjacent sides of

16 an object such as a pipeline 42 or in a back fill of a wall 48 or

in other targeted positions for the separated fill streams. By

adjusting the position of the flow director 14 by laterally
translating the telescopic conveyor 20 and adjusting the angles
and elevation of the individual channeling ramps 28

21 appropriately, the operator avoids damage to the pipe 42 which
could be caused by dropping fill material from the conveyor 20

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1 directly onto the pipe **42** or onto the pipe **42** at the wrong angle
or from the wrong elevation. The ability to adjust each
channeling ramp **28** independently of the other as depicted in
figure 4, allows the operator to deposit an exact volume of
material **22** on each side of the pipe **42** to bury and protect it.

6 Individual adjustment of the channeling ramps **28** to equal or
differing distances from a center line allows more or less fill
material to be deposited by one or the other of the channeling
ramps **28** on either side of a target.

Additional means for steering the placement of fill material
1 is provided the operator by a control allowing the operator to
change the speed of the conveyor **20** or the angle of one or both
of the channeling ramps **28** and the position of the flow director
over the target to be buried, all at the same time. This allows
the operator a constant ability and means of steering the
16 placement of the fill material **22** as well as a means for
determining the volume of material **22** placed in one or a
plurality of positions of the two separate material streams.

The conveyor **20** if powered by conventional hydraulic systems
which as noted above can be sped up or slowed in the conventional
21 fashion using levers to change the flow rate of the hydraulic
fluid powering the motors **25**. Or, if an electric motor is

1 instead used as a means to rotate the conveyor belt **21** on the
conveyor **20** its speed can be increased or decreased in a
conventional manner using electrical controls such as a
potentiometer to control the speed of the electric motor which
would communicate power to the belt **20** to rotate it.

6 Optionally, additional means for adjustment of the placement
of the bifurcated material stream may be provided by a swivel **44**
at the attachment point of the flow director **14** to the distal end
of the conveyor **20**. Such an option would allow the operator to
swivel the channeling ramps **28** to positions off the position
11 parallel to the conveyor **20** to allow for angled placement of fill
22 discharged by the distal ends of the channeling ramps **28**. The
swivel **44** can be hydraulically driven by a hydraulic motor **25** or
gear driven, or electrically driven, in the aforementioned
conventional manner of powering such construction equipment.

16 Additional utility is provided by an optional means for
altering the center of gravity of the hopper **12**. This ability to
adjust the massive weight imparted to the vehicle **12** by the load
of fill material **22** deposited in the hopper **12** solves another
vexing problem that exists with large machinery. Such machines,
21 due to their mass and odd center of gravity caused by irregular
shape and operational configurations, are prone to tip over when

1 the machine encounters a steep grade. The means for altering the
center of gravity of the hopper 12 allows the user, or a
computer, to adjust the angle of the hopper 12 from normal to the
vehicle 13 frame to a better angle, depending on the grade
encountered and upon the weight of the fill 22 placed in the
6 hopper 12.

As depicted in figure 5³, a means for adjustment of the
vehicle center of gravity is provided by the hopper being
attached to the vehicle chassis at an attachment point having a
hopper axil 46 which rotationally attaches the hopper 12 to the
1 chassis 16 of the powered vehicle 13. The axil 46 is situated at
the base of the hopper 12 thus allowing the entire hopper 12 to
rotate on the axil 46 at the connection point to the vehicle 13.
A means to tilt the hopper 12 which in this case is a hydraulic
ram 36 of the same operation as mentioned above. However, other
16 devices such as rack and pinion gearing, or electric solenoids
could be used if desired or on vehicles so powered.

The operator, or a computer, tracking the incline traversed
by the vehicle 13 and the mass of the fill material 22 carried in
the hopper 12 can therein tilt the hopper 12 one direction or the
21 other by rotating the hopper 12 on the hopper axil 46 to an
infinite number of different positions between the position of

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1 the hopper on level ground normal to the vehicle chassis **16** and
the maximum radius or degree of rotation of the container on the
hopper axil **46**. By changing the angle of the hopper **12** from a
position normal to the chassis **16**, the operator changes the
center of gravity of the entire vehicle **18** since the force of the
6 mass of the hopper is imparted to the vehicle **18** at the
connection point where the chassis **16** provides the mount for the
hopper axil **46**. By altering the angle of the hopper **12**, the
operator is able to traverse road surfaces of much greater
incline than can be achieved without the means for altering the
11 vehicle's center of gravity. Such an ability allows the operator
to use the vehicle **18** without fear of roll over that would occur
in vehicles without this ability to change the center of gravity.

While the best mode of the device herein disclosed is as a
single unit with the hopper **12** having a means to adjust the
16 center of gravity of the attached vehicle **13** and combined with
the flow director **14** mounted to the end of the conveyor **20**, it is
possible that the flow director could be made attachable to
existing conveyors already in use and such a use is anticipated.
Attaching the flow director to existing conveyors which lack any
21 means to bifurcate or control the volume of material being
deposited would significantly enhance such devices.

1 Consequently the flow director **14** can be configured with a
means of attachment to a conventional conveyor already in use to
provide the utility described above and to thereby increase the
effectiveness, accuracy and speed of such conventional conveyors
in depositing fill material on designated targets. Such a use is
6 anticipated due to the huge increase in utility attaching the
flow director **14** by itself to retrofit existing conveyors and
conveyor systems on such vehicles currently in use.

 Figure 6 depicts and additional preferred embodiment of the
device which takes advantage of the extendable conveyors **20** which
11 as noted working in the conventional fashion of a conveyor belt
and convey fill material **22** communicated from the hopper **12** at
the receiving end **23** and transport the fill material **22** on a
rotating belt **21** to the distal end **24** of the conveyor **20**. The
belt **21** would be powered by a conventional means for powering the
16 rotation of the belt such as a hydraulically powered motor or
electric motor. The distal end **24** of the conveyor **20** in this
case would not have the flow director **14** and would deposit the
material **22** on top of or on the adjacent sides of the pipe **42** or
other structure in the trench to be buried. This embodiment,
21 while not yielding all of the benefits of the embodiment with the
flow director **14** does offer a substantial improvement over the

1 conventional manner of filling a trench which involves the use of
a mechanical shovel or backhoe which picks up buckets of dirt or
fill material 22 and simply drops it in the trench.

Another preferred embodiment of figure 6 while simpler in
nature, still provides a vast improvement over the current method
6 of backhoes and piles of dirt. In this embodiment, the conveyor
20 would have first and second conveyor belts 21 with the distal
end 24 being laterally translateable in relation to the receiving
end 23 which would receive material from the vehicle mounted and
adjustable hopper 12 thereby providing a means to telescope the
conveyor 20 to longer or shorter lengths to position the distal
end 24 over the area to be filled. Thus, the second conveyor
belt 21 would receive fill material 22 from the first conveyor
belt 21 deposited there from the hopper 12 on the receiving end
23. The second conveyor belt 21 of the conveyor 20 would render
16 the distal end 24 user positionable over the center or sides of
the trench by laterally translating the distal end 24 to the
appropriate position to deposit fill material 22 in the desired
location. This lateral translation of the second conveyor belt
21 under the first conveyor belt 21 would be accomplished using
21 hydraulic cylinders 36 or similar conventional means. Of course
the conveyor 20 might be comprised of a single conveyor belt 21

1 which could laterally translate, the current best mode features a
 pair of conveyor belts **21** with the distal end **24** being on the
 conveyor belt **21** furthest from the hopper **12** and being laterally
 translateable. Optionally, the distal end **24** would also be
 adjustable for elevation using a means for adjustment of the
 6 elevation of the distal end **24** in the form of a conventional
 hydraulic cylinder **36** or similar controllable extension device to
 adjust the height of the distal end **24** above the trench by
 rotating the entire conveyor **20** at its connection below hopper **12**
 on the chassis **16**.

11 The conveyor **20**, using the vehicle mounted hopper **12** which
 itself is adjustable as noted above as a means to change the
 center of gravity of the vehicle for inclines, and the speed of
 the conveyor belts **21**, as well as the elevation of the distal end
24 and the laterally translated position of the distal end **24**,
 16 can all be combined and adjusted by the user to place the fill
 material **22** in the desired position in the trench. Thus, use of
 the telescoping or single piece conveyor **20**, and optional
 elevation adjustment thereof, attached to the tiltable vehicle
 mounted hopper **12**, provides a major increase in utility of trench
 21 filling over the aforementioned conventional manner of placing
 fill material **22** in a trench using a backhoe or similar shovel

1 device.

While all of the fundamental characteristics and features of the self propelled backfilling apparatus with controllable steering of fill material stream invention have been shown and described, it should be understood that various substitutions, 6 modifications, and variations may be made by those skilled in the art without departing from the spirit or scope of the invention. Consequently, all such modifications and variations are included within the scope of the invention as defined by the following claims.

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